LUBRICATION

Published by THE TEXAS COMPANY

17 Battery Place, New York City

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Edited by

L. H. CANFIELD, Ph. D.

VOL. V DECEMBER, 1917 No. 2

Published Monthly in the interest of efficient lubrication.

Change of Address—In reporting change of address, give both old and new address.

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EDITORIAL

The article on Steam Engine Lubrication supplements a series of articles published in recent issues on Steam Cylinder Lubrication, Steam Turbine Lubrication, and Air Compressor Lubrication, together with various articles on internal combustion engine lubrication. It is the purpose of this article to deal with crank case splash oiling systems, systems consisting of pump and filter, used chiefly on horizontal engines, and self-oiling systems, used on vertical engines. Automatic and crank case oiling systems impose very severe conditions upon the lubricating oil, and to withstand this service high quality oils are required. Texaco Regal Oil is a medium bodied oil which has been produced especially to meet these requirements.

The following is an editorial reprinted from *The Sun*, September 13, 1917, and Mr. W. F. Parish's reply published a few days later:

MODERN WHALING

Whaling is not an institution of the past on the Pacific coast, as it is at New Bedford, Nantucket and other historical fishing ports of the Atlantic. A dispatch from Aberdeen, Wash., announces the reward of a two days' hunting trip of one ship as six sperm whales, "a killing valued at $15,000." The catch of the whole season will be about 250 whales.

The oil of the big sperms remains one of the principal prizes of a whale hunt. If it lost its value as an illuminant when petroleum was discovered it returned to usefulness with the advent of big ocean liners and great battleships. There is nothing that will take the place of the old time "sperm oil" for use in the bearings of the enormous engines and complicated machinery of these modern vessels. So today the oil of the average sperm is worth about $3,000, as much as it was worth in the ancient days of the whaling industry.

But what a puzzle this report of a catch would be to the old time whaler:

"Seven tons, 14,000 pounds, of whale meat was taken recently from one finback, which is the largest amount of meat furnished by any whale taken this season."

Whale meat as food! The Pacific coast has taken to it and likes it. An Oakland, Cal., paper recently complained that a meat which had been "introduced to decrease the high cost of living" should be boosted until it was almost as expensive as beef. An Aberdeen paper says that the whale dispensary at that place can "put out enough of whale meat in a year to save 10,000 cattle and save the consumer $600,000 a year." Furthermore, it declares that there are enough whales to feed all the Allied nations, even if every day is a "beefless day."

In view of all these glowing reports and great promises for the future it is little wonder that the ancient industry of whaling has taken on a most profitable revival on the Pacific coast.

STEAMSHIP OILING

Not Sperm Oil but Mineral Oil is the Universal Lubricant

To the Editor of The Sun—

Sir: Referring to your editorial article entitled "Modern Whaling," I would say that sperm oil has not been used as a lubricant in the United States Navy for a considerable number of years. Since the advent of circulating systems for supplying turbines, forced feed systems for the reciprocating engines and internal combustion engines, it has been impossible to use sperm oil, as the character of this oil would not allow it to operate over a very few hours without causing damage and putting the machinery out of commission.

The Texas Company last year furnished over a million gallons of mineral oils to the vessels of the United States Navy; this amounted to practically 98 per cent. of all the lubricating oil used in that service. The contract for this year will of course cover a greater gallonage. All of this oil will practically be mineral oil, and as a matter of interesting information to you, over 75 per cent. of the oils furnished last year were of asphaltic base, coming from Texas crudes.

Sperm oil is not, to my knowledge, used anywhere in the United States as a lubricant in its natural state. It may be found in 10 per cent. to 20 per cent. mixtures of oil to be used as a lubricant for special work, such as knitting machines and in textile mills, the addition of the sperm oil to the mineral oil allowing the finished oil to wash out more readily if the goods is stained.

For your information I am attaching bulletin No. 17 issued by the Navy Department, showing the oils that are being used for lubrication of the United States fleet for the present year. These same oils are being used for the ships operated by the Shipping Board, which include the interned German liners and the merchant ships that are now operating in the transport and supply fleets.

As a matter of further interest, the other navies of the world are being lubricated with mineral oils for circulating and forced feed systems and for their internal combustion engines. The oils used for wick feeds, or what is known as hand oiling on reciprocating engines, will carry compounding, generally of vegetable origin, to an extent of not over 20 per cent. Sperm oil, however, is not used for compounding in any of the service with which I am familiar.

W. F. Parish,
Manager, Lubricating Division,
The Texas Company.

New York, September 19.

STEAM ENGINE LUBRICATION

CRANK CASE SPLASH OILING SYSTEMS AND AUTOMATIC OILING SYSTEMS

By W. F. Osborne

THE bearings of a steam engine may be lubricated in a number of ways, and the method used depends largely upon the size and the design of the engine, the speed at which it operates, and the quantity of oil required. These methods may be divided generally into two classes, namely, drip cup and continuous oiling.

A very large number of the older engines and some of the new engines are equipped with sight feed cups or a reservoir, by which the oil is fed drop by drop onto the bearing surfaces, affording intermittent lubrication. After the oil has passed through the bearings once, it is lost, and the oil consumption of such engines is necessarily rather high. The continuous oiling system automatically supplies an abundance of oil to all bearings, thus preventing dry or hot bearings due to inefficient lubrication. The increased flow of oil keeps the bearing surfaces washed clean of dust or small particles of worn bearing metals, and by removing these abrasive substances reduces bearing wear to a minimum. The oil also acts as a cooling medium by carrying away the frictional heat of the bearings, reducing the running temperature. When proper means is provided for collecting the oil and cleaning it of impurities, after it has passed through the bearings, these systems may be operated very satisfactorily on a very small consumption of lubricating oil.

The larger engines which require a considerable quantity of oil are usually equipped with continuous circulating systems, consisting of reservoirs, drain tanks, pumps, and filters for the continuous filtration and supplying of oil. The smaller units, particularly the high-speed engines, usually have the crank case and cross-head completely enclosed to prevent throwing of the oil due to the high speed, and on such units a splash oiling system or an automatic oiling system is employed. This method of lubrication will be the subject of this paper and, for detailed explanation, will be divided into three classes, crank case splash oiling systems, systems consisting of pump and filter, used chiefly on horizontal engines, and self oiling systems, used on vertical engines. Each of these types has its advantages and disadvantages, and when applied in the proper way to suitable designs will give equally good results as far as lubrication is concerned.

Crank Case Splash Oiling Systems—In general, these systems consist of troughs, oil grooves, and pipes in the engine frame which are supplied with oil picked up by the crank disc from the supply in the bottom of the crank pit. It is necessary that the crank, cross head, and other moving parts of the engine be completely enclosed so as to collect the oil thrown from the moving parts and return it to the crank pit for further use. So long as an ample supply of oil is maintained in the crank pit it is impossible for the bearings to run dry, unless the trough or oil ways become stopped up.

The advocates of the splash system claim that it is more reliable

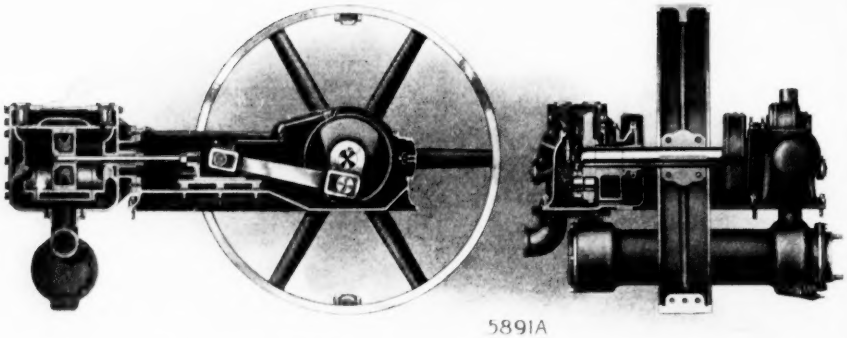

Figure 1—Bath Lubrication on Ingersoll-Rand Compressor

than any other type, because it has few pipes and no pumps or moving parts to get out of order, and because it supplies a maximum of oil to all bearings. This flood of oil washes out dirt and worn particles of metal from the bearings, keeping them clean and properly lubricated. Owing to the fact that the greater part of the oil is at all times held in the enclosed crank case, however, there is very little chance for radiation of the heat taken up from the bearings, and received by radiation and conduction from the steam cylinder. Naturally, the oil runs rather warm.

Another source of trouble is the condensation water from the steam cylinder, which frequently follows along the piston rods into the crank case. Some engines are equipped with bulk heads fitted with a stuffing box which wipes the greater part of the water off the piston rod, permitting it to collect in a drain pocket between the bulk head and the cylinder head. Most engines are also fitted with drains from the lowest part of the crank pit to permit of the water being drawn off at regular intervals and also for removing the oil when it is necessary to make a complete renewal. The bulk head also serves to prevent the oil from splashing against the cylinder head where it is burned, and this protection results in cooler oil and lower consumption. Some of the most widely known applications of this system are explained below.

The Ingersoll-Rand Imperial type air compressor was one of the first units to use the splash oiling system, and very economical results have been obtained. By referring to Figure 1 it can be observed that the frame on each side is enclosed by oil-tight covers. The crank disc is made with a smoothly turned flange which runs in the oil dipping about one and one-half inches and carrying the oil to the top where it is caught in a wiper or scraper resting lightly on the flange, whence it is conveyed directly to the main bearings, eccentric straps, crank pins, crosshead guides and piston rods. All of the oil delivered to the bearings is caught and returned to the crank pit, and may be used repeatedly. The steam driven units have a bulk head and extra stuffing box to remove the piston rod condensation.

As an example of the economy of this system, we quote from the literature put out by the Ingersoll-Rand Company, as follows:

"Experience has shown that a light 16″ stroke Imperial Compressor, operating ten hours per day, requires not more than six or seven

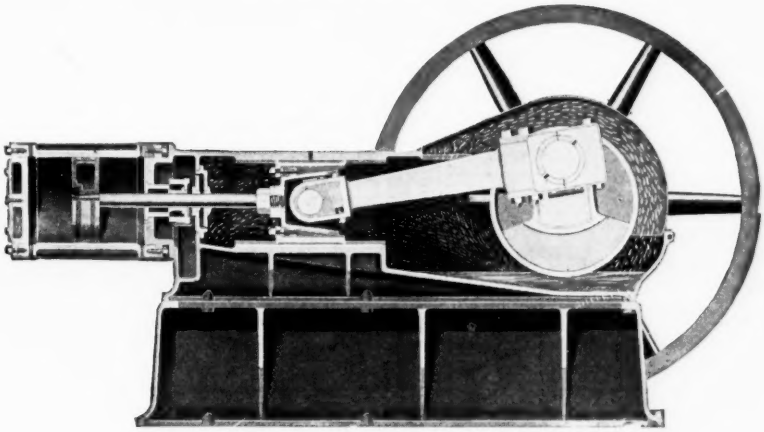

Figure 2—Splash System of Buffalo Horizontal Engine

gallons of oil per month added to that contained in the frame to make up for losses. The difference in cost of the Imperial Bath system and the open type of oil cup lubrication is about 38 cents per h.p. year. An air compressor of medium size (about 150 h.p.) would cost about $19.00 per horse power. Suppose the compressors are used only ten years. In that time the bath system would effect a saving of $570.00 or $3.80 per h.p.—about 20 per cent. of the cost of the compressor.

"In addition, a material saving would be effected thru the lesser attention required with the bath system of lubrication. This item has not been considered in the above figures."

The oiling systems of the Harrisburgh Engines are of the centrifugal type, in which a film of oil is carried up by the circular crank disc dipping from one-half to one inch into the main supply in the crank pit, and the centrifugal force throws a copious amount back on the guide. The crank disc also throws a continuous supply into a trough placed across the inside face of the hood and from there it is conveyed through a short tube to a point over the main bearing where a sight feed oil device is attached. A wall plate with a stuffing box prevents oils from splashing against the hot cylinder head, and also prevents the piston rod condensation working into the crank case.

The Buffalo Forge Company and the Fitchburg Steam Engine Company build engines using a very similar method of lubrication, the crank disc dipping about two inches into the oil in the crank case and throwing the oil to the guides and cross-head. Two interior frame pockets are kept filled with oil by the splash and lubricate the main bearings.

The service requirements of an oil used in crank case splash oiling systems are very severe, and an oil of high quality is necessary to meet these conditions. In the first place, the oil must have the proper body to withstand the bearing pressure at the temperature of operation. It must separate from water very readily to permit the condensation water to settle out in the bottom of the crank case where it is drained off through the opening provided.

This requirement necessitates the use of a filtered oil, as these oils will

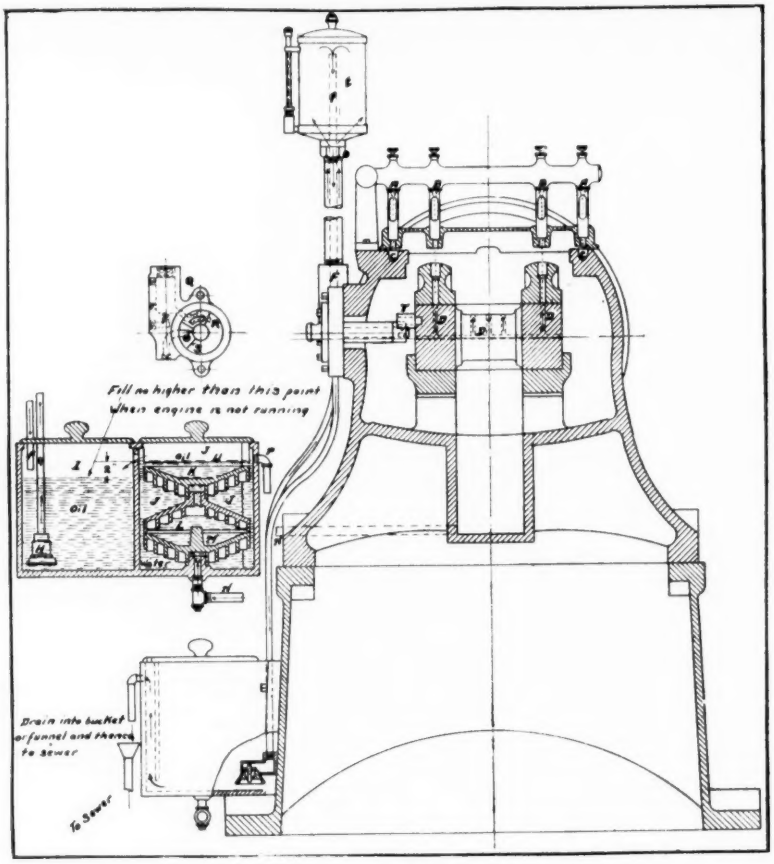

Figure 3—Oiling System on Skinner Engine

separate more readily than unfiltered oils. It must not have excessively volatile constituents which cause rapid evaporation of the oil when mixed with the air in the crank case, and it should flow readily at ordinary operating temperatures.

Pump and Filter Systems—The advocates of the pump and filter system claim that the use of a pump and filter results in a cooler and cleaner oil. By having clean oil the bearing friction and consequently the bearing wear is less than when dirty oil is used, and the bearings will therefore run at a lower temperature. The cleaning of the oil is accomplished by means of filters and water separators, which remove the water, dirt and dust, and small particles of worn bearing metal, which get into the oil. These filters and separators are so arranged that they may be cleaned at frequent intervals, some being equipped with automatic overflows which automatically take care of the water. The oil in running through these filters and separators and coming to rest in the reservoir, has an opportunity to become cooled through radiation, and the bearings naturally run somewhat cooler than

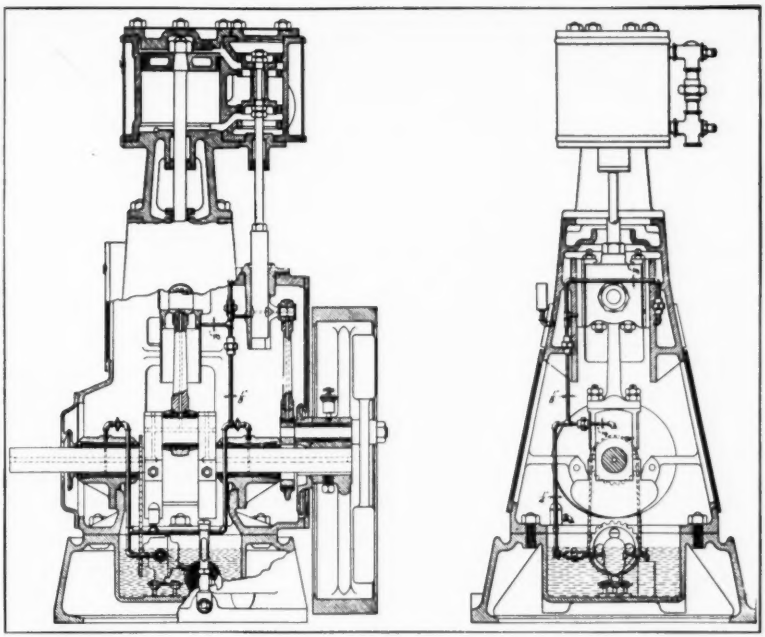

Figure 4—Pressure System on Sturtevant Vertical Engine

where the splash system is used. The quantity of oil supplied to the bearings is not as large as when the splash system is used.

Owing to the cooler temperature and the fact that the oil is not so thoroughly churned up with air in the crank case with the use of this system, the evaporation of oil is less than where the splash system is used. Where efficient separators and filters are in use there is probably not as great a loss due to the oil being drained out with the water of condensation as in the case of splash systems, where there is no opportunity for the oil to completely separate.

The practical test of any oiling system is its reliability. The pump and filter system has several moving and wearing parts which may become out of order, and pipes which may become stopped up. These parts sometimes have to be repaired, and occasionally fail altogether, in which case hot bearings result. This type of oiling system therefore requires a little more attention.

There are many types of automatic lubricating systems in use for horizontal engines, several of the most widely known being explained below.

The Skinner System of Automatic Lubrication consists of a "double-acting, positive-driven oscillating pump which has no stuffing box and cannot wear, leak, clog, or in any way become ineffective; an instantaneous oil and water separator by which every particle of piston stuffing box leakage is eliminated; an adjustable sight feeder through which the oil going to the bearings can be seen and the amount regulated; and an effective filter wherein the oil passing through twenty-eight feet of filtering medium in a film is thoroughly washed and the sediment deposited on the bottom. After the oil has been delivered to the bearings, it flows along the bottom of

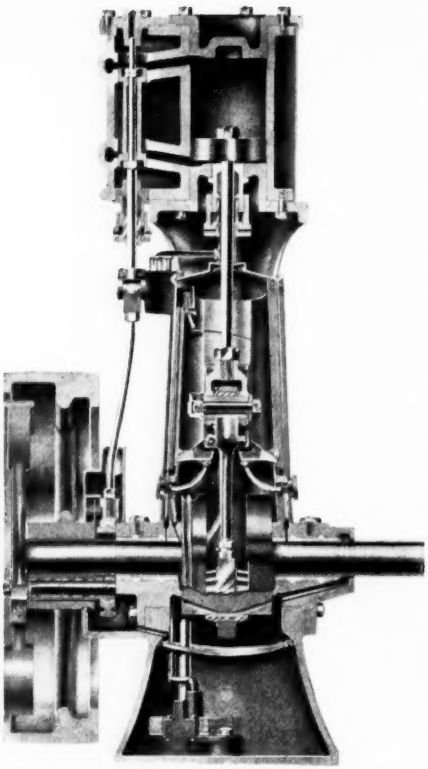

Figure 5—Lubricating Mechanism on New Style Engine of American Blower Company

the bed, where it is all cooled, filtered, and returned to the bearing."

The Ball Engine Company uses a "pump of such design that the suction and discharge ports are positively opened and closed at the proper time, which automatically returns the oil from the crank case to a filter placed on the top of the engine bed. Adjustable sight feeds are provided at each bearing and are supplied with clean oil from the filter." The Ames Iron Works use a similar method of lubrication, having an oil tank equipped with a filter on the top of the engine bed, the main bearing, cross-head pin, crank pin, rocker arm shaft, and eccentric being lubricated with sight feeds supplied from the reservoir. The requirements of an oil to work satisfactorily in these systems are practically the same as those of the splash system.

Vertical Engines—The greatest difficulty encountered in the lubrication of vertical engines is the piston rod condensation which will work its way through the best of packing and stuffing boxes, particularly where there are long steam lines and low steam pressures. Various methods have been used for taking care of this condensation, some of the most prominent types being explained in this article.

The Sturtevant Vertical Engine, Figure 4, shows the construction of the pressure system used by the B. F. Sturtevant Company on their high speed engines. A chain-driven rotary pump entirely submerged in the oil in the base forces the oil, under pressure, through the oil pipes to all the parts requiring lubrication. The oil drains back to the base where it is strained and again forced through the system. Another type of engine has a reservoir in the frame, and the oil flows by gravity to the various bearings. A distance plate and double stuffing box are used to reduce the amount of cylinder condensation which works into the oiling system.

The American Blower Company has a geared oil pump, located in the base, which pumps the oil to the various bearings. The oil returns to the bottom of the case and is used again. A baffle plate is provided to prevent an excessive quantity of cylinder condensation from getting to the crank case, and an automatic water overflow takes care of the little water that works through the stuffing boxes. This overflow should be kept open at all times so that it may be possible to tell when the oil starts to overflow.

The Troy Engine, as shown in

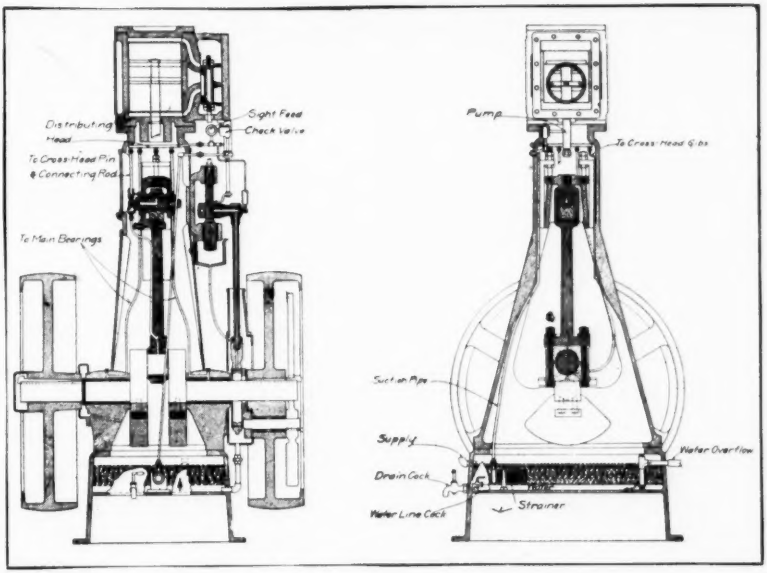

Figure 6—Lubricating System on Troy Engine

Figure 5, works on the same general principle, and has an automatic water overflow for removing the cylinder condensation.

One of the greatest causes of complaint on the lubrication of engines of this type is the emulsion formed in the base by the churning of the oil with the water from the piston rods. If a proper lubricant is used, which will readily separate from water without forming emulsions, this trouble may be eliminated by draining off the condensation water automatically or at regular intervals.

The general requirements of an oil for the proper lubrication of units equipped with continuous oiling systems of all of these types may be briefly stated as follows:

It should be of proper body at working temperature to provide a lubricating film between the bearing surfaces.

It should be filtered, as these oils separate readily from water, thus permitting the cylinder condensation to be drained off without the formation of emulsions.

It should not evaporate quickly at working temperature when churned up with air in the crank case.

It should be properly refined and contain no free acid.

These requirements have been carefully studied by the engineers of The Texas Company and TEXACO REGAL OIL has been developed to meet these special conditions in the most satisfactory manner.

THE MULTIWHIRL COOLER

OIL cooling for the lubrication of turbine bearings, heavy duty work generally, and for the circulating oil of quenching systems has in the past few years received considerable attention. The general

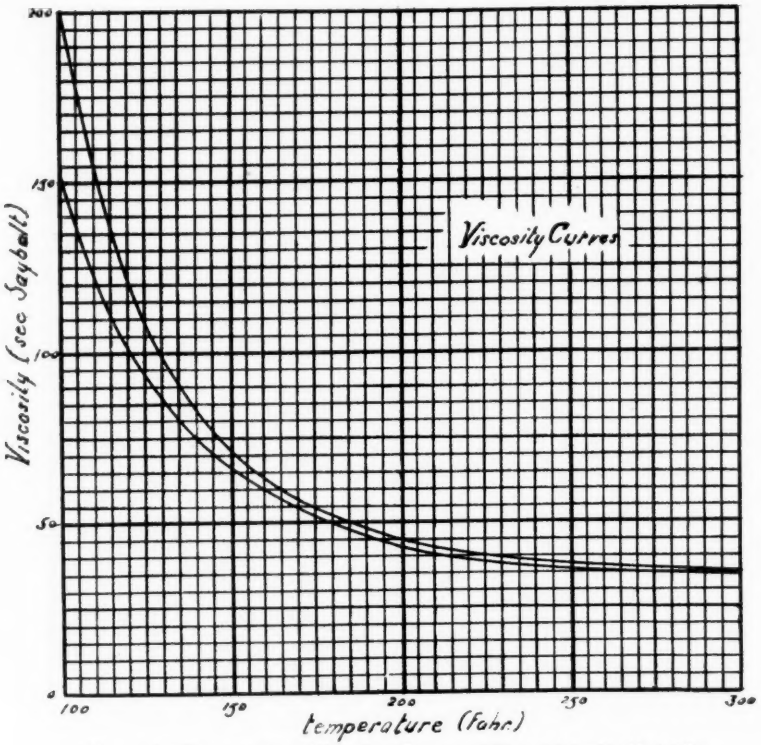

Figure 1—Temperature Viscosity Curves of Two Light Bodied Oils

subject is quite complex in that the variables encountered, which determine the required area of the transfer surface for any given form of cooler, depend not only upon the character of the oil, the inlet and outlet temperatures of the oil, the inlet temperature of the water and quantity-ratio of water to oil, but also very materially on the temperature level, or the portion of the temperature-viscosity curve through which the cooling is to take place.

The viscosity of the oil plays a most important part since the required transfer surface varies with it. It will be noted from Figure 1, illustrating typical curves of two well-known lubricating oils, the upper curve representing an asphaltic base and the lower curve a paraffine base oil, that for an oil cooling range of 20 degrees with initial temperature of 150 degrees F., there would be presented quite a different average viscosity than would be the case for the same oil through the same temperature range, but with an initial temperature of 130 degrees F.

We here show an ingenious device made by The Griscom-Russell Company of 90 West Street, New York, which is known as the Multiwhirl Cooler. This, we are informed, is the result of fifty years' experience in the design and manufacture of heat transferring apparatus. This new cooler has been exhaustively tested under various combinations of the above mentioned variables for many of the popular types of lubricating oil, and is now obtainable on guaranteed ratings in a great

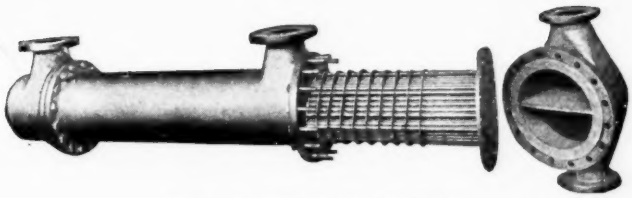

Figure 2—The Multiwhirl Cooler

variety of sizes. It is extensively used by our Navy and Merchant Marine, as well as by turbine manufacturers generally.

The operation of the Multiwhirl Cooler will be understood by reference to the accompanying illustration with the addition of the following remarks:

This cooler, which may with equal efficiency be placed in any position, is designed for oil in the shell and cooling water in the tubes. The oil flows along a smooth path afforded by the patent helical baffle construction, which gives an intimate presentation of the oil particles to the cooling surface with an unusually low pressure drop. Also, by virtue of the character of the whirling oil flow, the cooler will be found to maintain a better degree of cleanliness (on account of the scouring effect) than would be the case with appliances of other designs.

The tube system for the cooling water is made up of a considerable number of small tubes in two-pass arrangement, at one end rolled into a fixed tube plate and at the other end into a floating head. This allows separate expansion for the water and oil paths, eliminates temperature strains and prevents the water leaking into the oil.

Utmost precaution is taken to render the coolers clean so that no dirt will be carried to the turbine bearings. In this direction it may be mentioned that the shells are bored, which it will be noted removes any possible foundry scale.

It will be noted from the illustration that the entire tube bundle is removable for the purpose of inspection. Also, by removing the cover plate of the floating head, the interior of the tubes may be inspected without breaking the service connections.

We are informed that a long series of comparative tests has demonstrated that the Multiwhirl Cooler offers a considerably better efficiency of transfer per unit of surface than other coolers of commercial form, and, at the same time, the pressure drop is lower. So it may be safely stated that this appliance merits the investigation of interested engineers.

The following information was sent in by H. C. Baker, Cashier, at Canal Station, Port Arthur, Texas:

"Our tankwagon here at this station is on the go from six o'clock in the morning until five o'clock in the afternoon nearly every day in the week, except Sunday, making deliveries of five gallons and up. We have been using Texaco Star Grease No. 3 on it for the past several months. We gave the wagon a good greasing today for the first time in two weeks and it looked as though it could have gone several days longer without being greased. This wagon is not equipped with up-to-date axles but is just an ordinary wagon. I lived on a farm all my life until I began working for The Texas Company. We had about eight or ten wagons, and this is the best grease I have ever seen.

Speed Boat "Pickaninny"

TAYLOR EQUIPMENT CO.
1319 Buttonwood Street,
Philadelphia, Pa.

THE TEXAS COMPANY, October 12, 1917.
Widener Bldg., Philadelphia, Pa.

GENTLEMEN:

We have been in the Motorboat game for some six (6) or seven (7) years and have always used a HALL Gas Engine in our boat and have always used one grade of oil, up until the Championship Race on the Delaware River of this year, when we made a change and tried the "TEXACO MOTOR OIL HEAVY," which made our engine more active and work the best that we ever saw her work in the history of the boat, and we feel now that our winnings of the summer racing have been on account of making the change in the oil for the engine and beating the boys in "over the tape."

The "PICKANINNY" just returned from a Four Hundred (400) mile cruise down the Chesapeake Bay and return, and did not have the least bit of engine trouble or carbon trouble.

This boat has also been the winner of all prominent races of the Delaware River for 1917.

Yours very truly,

BELL & TAYLOR,
Per Howard Taylor.